

## ARTHROPODS DISTRIBUTION ACCORDING TO VEGETAL STRATA IN PEARS TREES ORCHARDS NEAR TADMAIT (GDE KABYLIE)

KAHINA BELMADANI<sup>1</sup>, HASSINA HADJSAID<sup>2</sup>, AATIKA BOUBEKKA<sup>3</sup>, BOUSSAD METNA<sup>4</sup>  
& SALAHEDDINE DOUMANDJI<sup>5</sup>

<sup>1,2,3,5</sup>Department of Agricultural and Forestry Zoology, Agronomical Upper National School, El-Harrach (Algiers), Algeria

<sup>4</sup>Department of Agronomy, University Mouloud MAMMERI (Tizi-Ouzou), Algeria

### ABSTRACT

#### Summary

In a pear trees orchard at Tadmaït (Gde Kabylie), a study was carried to examine the distribution of invertebrates according to vegetal strata. It has showed that invertebrates species are highly abundant in herbaceous stratum ( $S = 163$ ) sampled using a sweep net, followed by ground surface ( $S = 141$ ) inventoried by the use of Barber pots and by leafy crown ( $S = 58$ ) using the Japanese umbrella. In Barber pots *Tapinoma nigerrimum* (R.A. % = 714%) is the most abundant into of reaping net *Cochlicella barbara* records the highest rate (R.A. % = 9.8%) and with threshing technique thanks to Japanese umbrella, it is *Cacopsylla pyri* which records higher frequency (R.A. % = 43.6%). As to lushness, the higher diversity is recorded within herbaceous stratum with  $H' = 5.7$  bits followed by one of the crown  $H' = 3.1$  bits and at the end that one calculated for the ground surface which is  $H' = 2.4$  bits. As for equitability index at herbaceous stratum level ( $E = 0.8$ ), within of leafy crown ( $E = 0.5$ ) and near the ground ( $E = 0.3$ ). In Anova's variance analysis done for species gathered according to strata and during each season, the P value is lower to 0.00, for that reason, there is highly significant difference between captures of the three strata.

**KEYWORDS:** Pear Trees Orchard, Tadmaït (Gde Kabylie), Barber Pot, Reaping Net, Japanese Umbrella, Entomofauna

### INTRODUCTION

In the world, studies on pear trees orchards are axed rather on species of devastating insect notably on pear tree psyllid *Cacopsylla pyri* Linnée 1758, as in France (ARMAND *and al.* 1991; LYOUSOUFI *and al.* 1994a; LYOUSOUFI *and al.*, 1994b, LENFANT *and al.*, 1994, BUES and TOUBAN, 2000; DEBRAS, 2007) in Spain (GARCIA CHAPA *and al.*, 2005) and in the North of America (HORTON, 1999), it is the same in Algeria where researches have been realised on pear trees psyllid in the Mitidja' meadow by YACOUB (1998) on some bio ecological parameters and by ALLILI (2008) on populations dynamics of *Cacopsylla pyri* in relation of its natural enemies and with associated entomofauna. It is noted no study had been published on arthropods fauna distribution according to vegetal strata in pear trees orchard particularly near Tadmaït ( $36^{\circ} 44' N$ ;  $3^{\circ} 57' E$ ) in Grande Kabylie, neither nowhere else in Algeria. In order to gather maximum information's on this fauna at level of those three strata, ground surface, herbaceous stratum, and leafy crown, three types of technical traps are used, those of Barber pots, reaping with net and the branches' threshing on a Japanese umbrella.

### PRESENTATION OF TADMAIT, STUDY AREA

Tadmaït is presented as a wide valley dominated by Massif of Sidi Ali Bounab and crossed by Sebaou River

(Figure 1) it is spreading out on area of 63.7 km<sup>2</sup>. Tadmaït is situated in a dampness bioclimatic level with temperate winter. Year 2008 gathered 665.3 mm of precipitations which are irregular but badly distributed through the time. Annual temperature average is 17.7°C. Gaussen's embrothermic diagram of Tadmaït shows two periods, the first: dry and hot, the second: damp and cool. In Tadmaït region, pear trees orchard taken in consideration is situated in basin of Sebaou which contains marls and its texture is clayey and muddy (B.I.E.T. 2007).

## MATERIALS AND METHODS

Pear trees orchard is 40 years old and is spreading out on 1 hectare. Shrubby stratum is composed of *Pyrus communis* Linné, 1753 of Santa Maria variety grafted on frank pear. Recovering rate of the ground is of 63.6% by pear trees and of 2.7% by leafy stratum, which counts 11 botanical species with *Trifolium repens* L. and *Avena sterilis* L. But the most abundant is *Lolium mutiflorum* which participates the more with a rate of 0.8%. The only ones pesticides' treatments are performed only in March against psyllid. (As it's not possible to use the same technique for studying the invertebrate populations of the three strata, the operator is obliged to use three adequate methods). Three types of traps which are, Barber pots, reaping net and threshing on Japanese umbrella are applied nearly on 15 of every month, from June 2008 until May 2009. Eight of Barber pots are put in straight line with 5 meters' intervals on the same level curve aiming capture of Arthropods that are living on the ground surface. At the same time operator proceeds to 10 reaping net's blows, repeated three times, in threshing grass tuft to their bottom with the aim to trap invertebrates that are present on herbaceous stratum. As for use of Japanese umbrella on 3 trees according to cardinal directions, it helps particularly to evict insects which are frequenting pear trees' leafy crown. The collected species are placed in Petri dishes ready for species determination. The obtained results are operated by index as those of richness, centesimal frequency, Shannon-Weaver diversity, equal distribution and statistical techniques. Thus, there is a double comparison to be done, one of which will be between the strata and another one between the three techniques that were used.

## RESULTS AND DISCUSSIONS

Barber pots technique has allowed making an inventory of 2.620 individuals distributed between 141 species, 60 families, 19 orders, and 6 classes. Yet, ALILI (2008) in a pear trees orchard at Birtouta (36° 39' N, 3°, 00' E) mentioned 54 individuals distributed between 23 species, 19 families, 8 orders and 3 classes. Formicidae family is well represented (R.A. % = 81.1% > 2 x m; m = 5.3%) with dominating species *Tapinoma nigerrimum* (R.A. % = 71.4% > 2 x m; m = 0.7%; Ni = 1.871) followed by *Cataglyphis bicolor* (R.A. % = 7.7%). Since *Tapinoma nigerrimum* is frequenting Homopterous to feed with their honeydew's excretion, Its strong dominance within pear trees orchard may be particularly due to pullulating of pear trees' Psyllid (*Cacopsylla pyri* Linné, 1753) It develops important anthills within orchards. A particular attention should be reserved to *Tapinoma nigerrimum*, which begins its attacks on spring to the young leaves of some fruit trees. According to BERNARD (1972) *Tapinoma* is linked to human activities in agricultural environment. CAGNIANT (1973) reports that *Tapinoma nigerrimum* is present in all Algeria and it is very common in Grande Kabylie.

In medlar trees at Maâmria, CHIKHI and DOUMANDJI (2010) mention as well dominance state of Formicidae (R. A. % = 29.6%) with *Tapinoma simrothi* (probably *T. nigerrimum*) is the first (R.A. % = 10.2%). However at the station level of pear trees of Eucalyptus (36° 40' N, 3° 8' E), ALLILI (2008) mentions dominance of an undetermined species of *Cyclorrhapha* sp. 1 (R.A. % = 20.5 %). The calculated diversity for pear trees orchard at Tadmaït is 2.4 bits, value relatively high which explains diversity of this fauna. Best diversity is mentioned in an orange grove at El Djemhouria

(36°40' N; 3° 09'E) by MOHAMMEDI-BOUBEKKA *and al.* (2007) equal to 4.6 bits. In other agricultural systems, especially in the North of Benin HAUTIER *and al.* (2003) did not notice difference between various cultural associations where diversity fluctuates between 3.7 and 3.9 bits. Biodiversity variations of Arthropods in same agro system in South of Parisian Basin between years are underlined by VIAUX and RAMIEL (2004). Those authors note that diversity index fluctuates from year to the other, between 1.2 and 2.4 bits in large cultures. The equitability index recorded at Tadmaït is  $E = 0.3$ . For that reason, present populations of different species are found in unbalanced positions between them. In the contrary, CHIKHI and DOUMANDJI (2007) at Maâmria (36° 46'N.; 3° 16' E) note a strong equitability ( $E = 0.9$ ).

In the trees medlar plantation being neglected where no maintenance is observed, in this orchard a little perturbed, populations of present species have tendency to be in balanced position between them. This phenomena is noted in natural environment as it is in national park of Mont Babor by BENKHELIL and DOUMANDJI (1992) ( $0.64 \leq E \leq 0.9$ ). A whole of 1.829 invertebrates are trapped at herbaceous stratum level in pear trees orchard at Tadmaït thanks to reaping net. They belong to 4 classes, 17 orders, 71 families and 163 species, which corresponds to a high richness (S). Value of S noted in the same conditions in the trees pistachio plantation at Beni Tamou (36° 23' N.; 2° 50' E.), by BOUKEROUI *and al.* (2007) is lower reaching hardly 45 species and consisted of 754 individuals belonging to 4 classes and to 17 orders. It is *Cochlicella barbara* (Table 1) which have higher level among present species (R.A. % = 9.8%; Ni = 180 individuals). Fulgoridae species keep the second rank with 137 individuals (R.A. % = 7.4%). TOLEDO PANOS (2004) wrote about molluscs that those devastating insects are present in most of Spanish wine growing regions and may cause important damages on the most of irrigated variety of vine.

As for BOUKEROUI *and al.* (2007), they point out that *Theba (Euparypha) pisana* is abundant in herbaceous stratum. In orchard of Tadmaït although herbaceous stratum richness is only of 11 plants species, number of host invertebrates is high, implicating a strong Shannon-Weaver index equal to 5.7 bits. This value to move closer to that reported by BOUKEROUI *and al.* (2007) which mentioned 5.3 bits as for trapped fauna of the same way in an orchard of tree pistachio at Beni-Tamou (Blida). Nearly 4.5 bits are noted by DEHINA *and al.* (2007) in citrus fruit plantation situated near Heraoua (36°47' N; 3° 15'E). Equitability value is equal to 0.8 which implicates that present populations of different invertebrates species have tendency to be balanced between them. This result confirms the one of DEHINA *and al.* (2007). Sampling fulfilled with Japanese umbrella at Tadmaït in the same plantation allowed to capture 557 invertebrates corresponding to 58 species, with less richness according to those mentioned at the surface of the ground and even in herbaceous stratum. This difference results without doubt from microclimates differences between foliation of pear trees more exposed to winds and to lowest temperatures than of herbaceous stratum level and of ground surface. It is possible that populating in invertebrates of pear trees foliation may be less diversified than lowest strata for that reason there is unique vegetal specie. In the other hand, carpet formed by adventitious is favoured by large diversity of ecological niches and by plants species composing it.

Those ones offer during long time refuges and more flowers to gather pollen from spacing out flowering period and attracting so great number of invertebrate's species. Value S is equal to 58 species with concerns pear trees flowering at Tadmaït is twice higher than which is found in medlar trees at Maâmria by CHIKHI and DOUMANDJI (2007) noting 29 species in 2002 and that is equal to 30 species pointed out in a forest in Lorraine by VALLET *and al.* (2004). At Tadmaït at level of leafing crown specie, *Cacopsylla pyri* has the higher centesimal frequency (R.A. % = 43.6%, Ni = 243 individuals). MILAIRE (1987) reported that *Cacopsylla pyri* is dominating specie among three species of Psyllid

that coexist in region of large fruit trees production in South of Europe. The last quoted author specifies that damages progression due to psyllid during years 1970 is understood, in those regions, by rigorous measures going until to plantations uprooting. Shannon-Weaver index of species which frequent pear tree leafing crown at Tadmaït is equal to 3.1 bits. Yet ALILI (2008) in comparable orchard situated at Eucalyptus shows 4.1 bits. BENKHELIL and DOUMANDJI (1992) note in forestry environment at Mont Babor high values of the diversity ( $4 \text{ bits} \leq H' \leq 5.6 \text{ bits}$ ). Recorded index equitability at Tadmaït is equal to 0.5.

For that reason it exists weak tendency towards balance between populations of different present species. This value is lower to the one found in tree pistachio plantation at Beni-Tamou by BOUKEROUI and *al.* (2007) ( $E = 0.8$ ). Previous remarks are supported by analysis of Anova's variance done for gathered species according to strata and during each season. At the end of this analysis, P value obtained is lower to 0.005. For this reason, there is a very high significant difference between the samples taken from the ground surface, those obtained from the herbaceous stratum and those recorded at the level of pear trees foliation. This very highly significant difference also exists between the three sampling techniques that were implemented.

## CONCLUSIONS

Distribution study of invertebrates according to vegetal strata within pear tree orchard highlights some distinctive features. In effect from fauna point of view herbaceous carpet composed from adventitious plants is richer in species ( $S = 163$ ) than higher stratum, this of pear trees foliation. Also arthropodofauna of herbaceous stratum appears more diversified with  $H' = 5.7 \text{ bits}$  than the two others studies level. Demographic distribution between species tends to a balance ( $E = 0.8$ ). It is useful to underline that in spite of fauna richness importance living at the ground surface ( $S = 141$ ), the composed species diversity is relatively low ( $H' = 2.3 \text{ bits}$ ) and that demographic distribution between species tends towards imbalance ( $E = 0.3$ ). Between populating of three strata, the one of half-length or herbaceous stratum appears more stable which populations are more balanced. On the other hand, either at the ground surface or in foliation species populations have tendency to be out of balance. Thanks to more meticulous device, it would be instructive to surround seriously parameters which play a part into this phenomenon.

## REFERENCES

1. ALILI F., 2008 - *Psylle du poirier Cacopsylla pyri (Homoptera, Psyllidae) à Birtouta, aux Eucalyptus et à Réghaïa : dynamique des populations, ennemis naturels et entomofaune associée*. Thèse Magister, Inst. nati. agro. El Harrach, 182 p.
2. ARMAND E., LYOUSOUFI A. et RIEUX R., 1991 - Evolution du complexe parasitaire des psylles du poirier *Psylla pyri* et *Psylla pyrisuga* (Homoptera : Psyllidae) en vergers dans le sud-est de la France au cours de la période hivernale, printanière et estivale. *Entomophaga*, 36 (2) : 287-294.
3. BENKHELIL M.-L. et DOUMANDJI S., 1992 - Notes écologiques sur la composition et la structure du peuplement des coléoptères dans le parc national de Babor (Algérie). *Med. Fac. Landbouww., Univ. Gent*, 57/ 3 a: 617 - 626.
4. B.I.E.T., 2007 – *Monographie communale et esquisse du schéma directeur de gestion des déchets municipaux*. Bureau d'Ingénierie et d'études Techniques (B.I.E.T.), Tadmaït-Tizi-Ouzou, 16 p.

5. BOUKEROUI N., DOUMANDJI S. et CHEBOUTI-MEZIOU N., 2007 - L'entomofaune du pistachier fruitier (*Pistacia vera* Linné) dans la région de Blida. *Journées Internati. Zool. agri. for.*, 8 - 10 avril 2007, *Dép. Zool. agri. for., Inst. nati. agro., El Harrach*, p. 203.
6. BUES R., TOUBON J. F. et BOUDINHON L., 2000 - Genetic analysis of resistance to azinphosmethyl in the pear psylla *Cacopsylla pyri* en Espagne. *Entomologia Experimentalis et Applicata*, 96: 159 -166.
7. CAGNIANT H., 1973 - *Les peuplements de fourmis des forêts algériennes - écologie, biocoenotique, essai biologique*. Thèse Doctorat es-sci. natu., Univ. Paul Sabatier, Toulouse, 464 p.
8. CHIKHI R., et DOUMANDJI S., 2010 – La diversité faunistique et relation trophique dans un verger de néfliers à Rouiba (Mitidja orientale) et le problème des dégâts des oiseaux. *Journées nati. Zool. agri. for.*, 19 - 21 avril 2010, *Dép. Zool. agri. for., Ecole nati. sup. agro., El Harrach*, p. 58.
9. DEBRAS J. F., 2007 - *Rôles fonctionnels des haies dans la régulation des ravageurs : le cas du psylle *Cacopsylla pyri* L. dans les vergers du Sud-Est de la France*. Thèse Doctorat état, Inst. nati. rech. agro. Univ. Avignon, Vaucluse, 240 p.
10. DEHINA N., DAOUDI-HACINI S. et DOUMANDJI S., 2007 – Arthropodofaune et place des Formicidae dans un milieu à vocation agricole. *Journées Internat. Zool. agri. et for.*, 8 - 10 avril 2007, *Dép. Zool. agri. for., Inst. nati. agro., El Harrach*, p. 201.
11. GARCIA-CHAPA M., SABATE J., LAVINA A. and BATLLE A., 2005 - Role of *Cacopsylla pyri* in the epidemiology of pear decline in Spain. *European J. Plant Pathol.*, 111: 9-17.
12. HAUTIER L., PATINY S., THOMAS-ODJO A. et GASPARD M. Ch., 2003 - Evaluation de la biodiversité de l'entomofaune circulante au sein d'associations culturales au Nord Bénin. *Notes faunistiques de Gembloux*, 52 : 39 - 51.
13. HORTON D. R., 1999 - Monitoring of pear *Psylla* for pest management decisions and research. *Integrated Pest Management Reviews*, 4: 1-20.
14. LENFANT C., LYOUSOUFI A., CHEN X., FAIVRE D'ARCIER F. et SAUPHANOR B., 1994 – Potentialités prédatrices de *Forficula auricularia* sur le psylle du poirier *Cacopsylla pyri*. *Entomol. Exp. Appl.*, 73 (1): 51- 60.
15. LYOUSOUFI A., GADENNE C., RIEUX R. et FAIVRE D'ARCIER F., 1994a - Evolution de la diapause du psylle du poirier *Cacopsylla pyri* dans les conditions naturelles. *Entomol. Exp. Appl.*, 70 : 193-199.
16. LYOUSOUFI A., GADENNE C., RIEUX R. et FAIVRE D'ARCIER F., 1994b - Effets d'un régulateur de croissance d'insectes, le fénoxycarbe, sur la diapause du psylle du poirier *Cacopsylla pyri*. *Entomol. Exp. Appl.*, 72 : 239 - 244.
17. MILAIRE H. J., 1987 – La protection phytosanitaire des vergers de pommiers et de poiriers par la lutte intégrée. *Phytoma, Déf. Vég.*, 392 : 38 - 49.
18. MOHAMMEDI-BOUBEKKA N., DAOUDI-HACINI S. et DOUMANDJI S., 2007 - Biosystématique des Aphidae et leur place dans l'entomofaune de l'oranger à El Djemhouria (Eucalyptus). *Journées Internat. Zool. agri. et for.*, 8 - 10 avril 2007, *Dép. Zool. agri. for., Inst. nati. agro., El Harrach*, p. 209.

19. TOLED-PANOS J., 2007 – *Les parasites de la vigne, stratégie de la lutte raisonnée*. Ed. Dunod, Paris, 429 p.
20. VALLET A., LOUBERE M., JACTEL H., JACQUEMIN G., DUPUEY J.-L. et DAMBRINE E., 2004 – Effets à long terme des pratiques agricoles sur les populations d'Arthropodes : inventaire du site de Thuilley-aux-Groseilles (54). *Sylvia, colloque forêt, archéol. Environ.* 14 – 16 décembre 2004, *Inst. nati. rech. agro. et Direction rég.aff. cultur. Lorraine* : 255 – 260.
21. VIAUX Ph. et RAMEIL V., 2004 – Impact des pratiques culturales sur les populations d'Arthropodes des sols de grandes cultures. *Phytoma, Def. Vég.*, 570 : 8 – 11.
22. YACOUB S., 1998 - *Contribution à l'étude de quelques paramètres bioécologiques de *Cacopsylla pyri* (Linné, 1758) (Homoptera : Psyllidae), en verger de poirier dans la région de Soumàa*. Thèse Ingénieur, Inst. agro, Univ. Sci. Techn., Blida, 64 p.

## APPENDICES

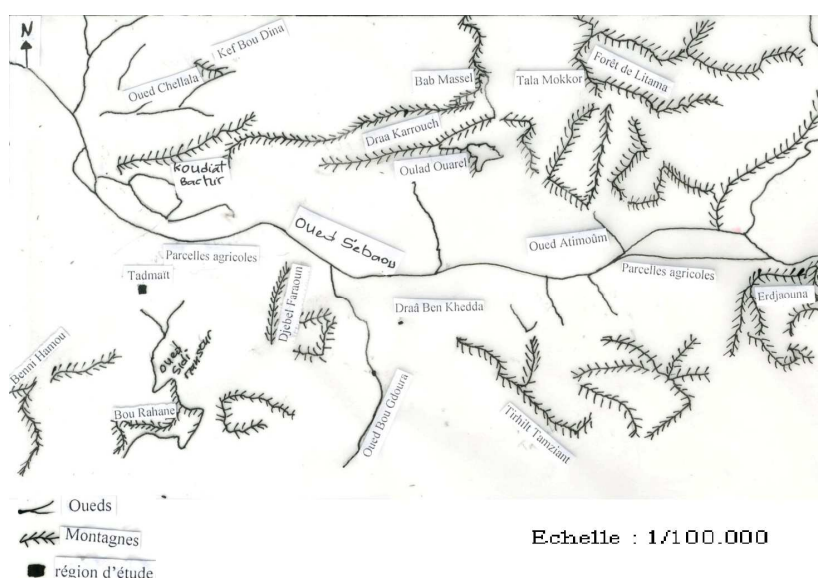


Figure 1: Location of Tadmaït

Table 1: Relative Abundances of Some Invertebrate Species Captured with the Three Sampling Techniques at Tadmaït

Orders (*)	Species	B.P.	R.A (%)	R. N.	R.A (%)	J.E.	R.A (%)
Oligocheta O. ind. (1)	Oligocheta sp. ind.	2	0,08	-	-	-	-
Pulmonae (8)	<i>Cochlicella barbara</i>	5	0,19	180	9,77	8	1,37
Aranea (46)	<i>Lepthyphantes</i> sp.	3	0,11	10	0,54	3	0,52
	Aranea sp 9 ind.	29	1,11	-	-	4	0,69
Acari (3)	Oribates sp. ind.	1	0,04	2	0,11	4	0,69
Isopoda (2)	Oniscidae sp. ind.	5	0,19	1	0,05	1	0,17
Chilopoda (1)	<i>Scutigera coleoptrata</i>	2	0,08	-	-	-	-
Thysanourata (1)	Lepismatidae sp. ind.	1	0,04	-	-	-	-
Podurata (5)	Entomobryidae sp. 1 ind.	34	1,30	12	0,65	1	0,17
	<i>Sminthurus</i> sp.	5	0,19	35	1,90	-	-
Blattoptera (2)	<i>Lobolampra</i> sp.	1	0,04	-	-	-	-
Mantidea (1)	<i>Ameles objecta</i>	-	0,00	1	0,05	-	-
Dermaptera (3)	<i>Nala lividipes</i>	6	0,23	1	0,05	-	-
Thysanoptera (2)	<i>Thysanoptera</i> sp. 1 ind.	-	-	33	1,79	-	-
Psocoptera (2)	Psocoptera sp. ind.	1	0,04	4	0,22	9	1,55

Table 1: Cond.,

Hémiptera (15)	Legaeidae sp. 1 ind.			34	1,84	1	0,17
	<i>Coryzus</i> sp.	-	-	51	2,77	-	-
	<i>Nysius</i> sp.	-	-	6	0,33	-	-
	Jassidae sp. 10 ind.	2	0,08	106	5,75	-	-
	Fulgoridae sp. ind.	1	0,04	137	7,43	1	0,17
Homoptera 26	<i>Cacopsylla pyri</i>	2	0,08	35	1,90	243	43,60
	<i>Macrosiphum</i> sp.	-	-	11	0,60	-	-
Neuroptera (1)	<i>Aleuropteryx lutea</i>	-	-	1	0,05	-	-
Coleoptera (80)	<i>Anthicus floralis</i>	61	2,33	-	-	-	-
	<i>Podagricus fuscipes</i>	3	0,11	9	0,49	1	0,17
Hymenoptera (34)	<i>Tetramorium biskrensis</i>	6	0,23	-	-	1	0,17
	<i>Tapinoma nigerrimum</i>	1871	71,44	46	2,50	81	13,92
	<i>Plagiolepis schmetzi</i>	10	0,38	33	1,79	17	2,92
	<i>Cataglyphis bicolor</i>	201	7,68	-	-	-	-
	<i>Apis mellifera</i>	2	0,08	1	0,05	-	-
Lepidoptera (4)	Lepidoptera sp. ind.	2	0,08	7	0,38	-	-
Diptera (25)	<i>Sepsis</i> sp.	-	-	21	1,14	-	-
Neuroptera (1)	<i>Chrysoperla carnea</i>	1	0,04	10	0,54	9	1,55

(\*) numbers of species, R.A %: relative abundances in percentage, BP: Barber pots, R.N.: reaping net, J.E. Japanese umbrella

